

Appl. No. 10/699,440
Amdt. dated June 26, 2006
Reply to Office Action of May 08, 2006

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 1 Claim 1 (currently amended): A film surface imprinted with
- 2 nanometer-sized particles to produce micro- and/or nano-
- 3 structured electron and hole collecting interfaces, comprising;
- 4 at least one transparent substrate;
- 5 at least one photoabsorbing conjugated polymer applied on a
- 6 first said substrate, wherein said conjugate polymer includes
- 7 polybutylthiophene (pbT);
- 8 a ~~sufficient amount~~ plurality of nanometer-sized particles
- 9 including multiwalled carbon nanotubes (MWNT) to, wherein said
- 10 plurality of nanometer-sized particles including said multiwalled
- 11 carbon nanotubes produce a charge separation interface;
- 12 at least one transparent polymerizable layer including a
- 13 sol-gel or monomer,
- 14 said MWNT embedded in said conjugated polymer to produce a
- 15 mixture and applied on a second said substrate to form a MWNT

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16 bearing surface film layer to form a stamp surface;
17 wherein said stamp surface is imprinted into the surface of
18 said polymerizable film layer to produce micro- and/or nano-
19 structured electron and hole collecting interfaces;
20 polymerizing said polymerizable film layer to promote
21 shrinkage to form a conformal gap between said MWNT stamp surface
22 and said surface of said polymerizable film layer; and
23 filling said gap with at least one photoabsorbing material
24 to promote the generation of photoexcited electrons and transport
25 to the charge separation interface.

1 Claim 2 (Original): The film according to claim 1, wherein either
2 said polymerizable layer and said conjugated polymer is applied
3 by processes comprising at least one of spin-coating, dip-
4 coating, spray-coating, flow-coating, doctor blade coating, and
5 screen-printing.

1 Claim 3 (currently amended): The film according to claim 1,
2 wherein said nanometer-sized particles comprise at least 1.5 mg
3 of said multiwalled carbon nanotubes having average particle
4 sizes of about 1 nm to about 100 nm in diameter and up to about 1

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5 nm to about 1 cm in length.

1 Claim 4 (original): The film according to claim 3, wherein said
2 nanometer-sized particles having average particle sizes of about
3 1 nm to about 100 nm in diameter and up to about 1 nm to about
4 500 nm in length.

1 Claim 5 (currently amended): The film according to claim 1,
2 wherein said nanometer-sized particles further comprises at least
3 one of SWNT single-walled carbon nanotubes (SWNT), and
4 nanocrystals of semiconductor materials.

1 Claim 6 (Original): The film according to claim 5, wherein said
2 nanocrystals of semiconductor materials comprises at least one of
3 CdSe, metal nanowires, and metal-filled carbon nanotubes.

1 Claim 7 (Original): The film according to claim 1, wherein
2 applying said polymerizable film layer ranging in thickness from
3 about 1 nm to about 1 mm.

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1 Claim 8 (Original): The film according to claim 1, wherein
2 applying said conjugated polymer mixture ranging in thickness
3 from up to about 100 nm.

1 Claim 9 (Original): The film according to claim 1, wherein said
2 polymerizable layer comprises at least one monomer film.

1 Claim 10 (Original): The film according to claim 1, wherein said
2 polymerizable layer comprises at least one sol-gel film.

3 Claim 11 (Original): The film according to claim 1, wherein said
4 sol-gel includes absolute alcohol and ultrapure water in a ratio
5 of about (1:0.025) and said metal oxide includes titanium oxide
6 and/or zinc oxide.

1 Claim 12 (Original): The film according to claim 1, wherein said
2 monomer comprising at least one of oxadiazole, aniline, and
3 pyrrole.

1 Claim 13 (Original): The film according to claim 1, wherein said

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2 photoabsorbing material comprises at least one of thermotropic
3 liquid crystalline materials, polybutylthiophene
4 (pbT)/chlorobenzene, and polyelectrolytes.

1 Claim 14 (currently amended): A film surface imprinted with
2 nanometer-sized particles prepared by a process to produce micro-
3 and/or nano-structured electron and hole collecting interfaces,
4 comprising:

5 providing at least one transparent substrate;

6 providing at least one photoabsorbing conjugated polymer;

7 providing a ~~sufficient amount~~ plurality of nanometer-sized
8 particles to produce a charge separation interface;

9 providing at least one transparent polymerizable layer
10 including a sol-gel or monomer;

11 embedding said nanometer-sized particles in said conjugated
12 polymer;

13 applying said polymerizable layer on a first said substrate
14 to form a charge transport film layer;

15 applying said conjugated polymer/nanometer-sized particle
16 mixture on a second said substrate to form a nanometer-sized
17 particles bearing surface film layer, wherein said nanometer-

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18 sized particles form a stamp surface;
19 imprinting said stamp surface into the surface of said
20 polymerizable film layer to produce micro- and/or nano-structured
21 electron and hole collecting interfaces;
22 polymerizing said polymerizable film layer to promote
23 shrinkage to form a conformal gap between said stamp surface and
24 said surface of said polymerizable film layer; and
25 filling said gap with at least one photoabsorbing material
26 to promote the generation of photoexcited electrons and transport
27 to the charge separation interface.

1 Claim 15 (Original): The film according to claim 14, wherein said
2 imprinting includes compressing and thereafter, solidifying said
3 stamp surface into said surface of said polymerizable layer.

1 Claim 16 (currently amended): The film according to claim 14,
2 wherein said nanometer-sized particles comprise at least 1.5 mg
3 of multiwalled carbon nanotubes having average particle sizes of
4 about 1 nm to about 100 nm in diameter and up to about 1 nm to
5 about 1 cm in length.

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1 Claim 17 (Original): The film according to claim 16, wherein said
2 nanometer-sized particles having average particle sizes of about
3 1 nm to about 100 nm in diameter and up to about 1 nm to about
4 500 nm in length.

1 Claim 18 (currently amended): The film according to claim 14,
2 wherein said nanometer-sized particles further comprises at least
3 one of SWNT single-walled carbon nanotubes (SWNT), and
4 nanocrystals of semiconductor materials.

1 Claim 19 (Original): The film according to claim 18, wherein said
2 nanocrystals of semiconductor materials comprises at least one of
3 CdSe, metal nanowires, and metal-filled carbon¹ nanotubes.

1 Claim 20 (Original): The film according to claim 14, wherein
2 applying said polymerizable film layer ranging in thickness from
3 about 1 nm to about 1 mm.

1 Claim 21 (Original): The film according to claim 14, wherein
2 applying said conjugated polymer mixture ranging in thickness
3 from up to about 100 nm.

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4 Claim 22 (Original): The film according to claim 14, further
5 comprising electrophoretically depositing said nanometer-sized
6 particles onto said polymerizable layer.

1 Claim 23 (Original): The film according to claim 22, wherein said
2 nanometer-sized particles include TiO_x nanometer-sized particles.

1 Claim 24 (Original): The film according to claim 14, wherein said
2 sol-gel includes absolute alcohol and ultrapure water in a ratio
3 of about (1:0.025) and a metal oxide.

1 Claim 25 (Original): The film according to claim 24, wherein
2 said metal oxide comprises at least one of inorganic metal salts
3 and metal organic compounds.

1 Claim 26 (Original): The film according to claim 25, wherein
2 said metal organic compounds include metal alkoxides comprising
3 at least one of titanium isopropoxide and zinc butoxide.

1 Claim 27 (Original): The film according to claim 14, wherein
2 said monomer comprising at least one of oxadiazole, aniline, and

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3 pyrrole.

4 Claim 28 (Original): The film according to claim 14, wherein
5 said substrate acts as an electrode by comprising a coating of at
6 least one transparent metal oxide including SnO₂:F, SnO₂:In
7 (ITO), and Au.

1 Claim 29 (Original): The film according to claim 14, wherein
2 said substrate acts as an electrode by comprising a coating of at
3 least one transparent metal oxide being conducting polymers
4 including polythiophenes, polypyrroles, polyanilines, and
5 polybutylthiophenes.

1 Claim 30 (Original): The film according to claim 14, wherein
2 said conjugated polymer includes pbT dissolved in chlorobenzene.

1 Claim 31 (Original): The film according to claim 14, wherein
2 said photoabsorbing material comprises at least one of
3 thermotropic liquid crystalline materials, polybutylthiophene
4 (pbT)/chlorobenzene, and polyelectrolytes.

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1 Claim 32 (Original): The film according to claim 14, wherein
2 said substrate comprises at least one of silicon, silicate,
3 plastic, and plastic-like materials.

4 Claim 33 (Original): The films surface imprinted with nanometer-
5 sized particles are obtained by the process defined in claim 14.

1 Claim 34 ((Original): The film according to claim 1, wherein said
2 film being utilized in a photovoltaic device or other light
3 guiding device.

Claim 35 (canceled).

Claim 36 (canceled).